PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of

Marshall W. Bern et al.

Application No.: New U.S. Non-Provisional Application

Filed: January 16, 2002   Docket No.:   105886

For: METHOD AND APPARATUS FOR IMPROVING IMAGE APPEARANCE

PRELIMINARY AMENDMENT

Director of the U.S. Patent and Trademark Office
Washington, D. C. 20231

Sir:

Prior to initial examination, please amend the above-identified application as follows:

IN THE SPECIFICATION:

Please replace paragraph [003] as follows:

[003] Various attempts at remedying such problems have been performed. An example is U.S. Patent No. 5,303,313 to Mark et al., which provides a method of image enhancement through use of a compressed representative image. Another example is described in J.D. Hobby et al., "Enhancing degraded document images via bitmap clustering and averaging," ICDAR '97: *Fourth Int. Conference on Document Analysis and Recognition, 1997.* Both Patent No. 5,303,313 and the Hobby article provides a basic strategy. In Hobby, the strategy includes: clustering bitmaps, computing representatives for each cluster, and then assembling an output. For initial clustering, Hobby uses a feature-based approach. To computer cluster representatives, Hobby uses a method that aligns the scans by centroids of black pixels, sums the scans to give a histogram, smooths the histogram to give a gray-level representative, and determines a polygonal outline that stays within a certain gray "tube" yet has a minimum number of inflection points. This computation method is described in J.D. Hobby and H.S. Baird, "Degraded Character Image Restoration", *Proc. 5th Annual Symp. On Document Analysis and Image Retrieval,* 1996, pps. 177-189. To align and form the

assembled output, Hobby appears to use the alignment computed when computing cluster representatives. Patent No. 5,303,313 does not perform any reclustering, and instead is concerned primarily with compression.

Please replace paragraph **[006]** as follows:

[006] The methods and systems of this invention separately reduce image degradation that appear in the captured bilevel image.

Please replace paragraph **[008]** as follows:

[008] This invention separately provides systems and methods that have more reliable initial clustering, a reduction of clusters without introducing any significant decrease in image quality, super-resolved placement of representatives, and other image enhancement including breaking-up of run-together letters of text.

Please replace paragraph **[009]** as follows:

[009] In various exemplary embodiments of the methods and systems according to this invention, the output image may have higher resolution than the input image.

Please replace paragraph **[0013]** as follows:

[0013] In various exemplary embodiments of the methods and systems according to this invention, cluster representations are determined by using a hill-climbing optimization procedure to approximate the most probable higher resolution representative. This has the advantage that it can rigorously incorporate Bayesian priors and learned or guessed scanner distortion parameters resulting in more accurate sharp features and reliable overall blackness. However, other optimization procedures can be substituted.

Please replace paragraph **[0015]** as follows:

[0015] In various exemplary embodiments of the methods and systems according to this invention, the assembly places representatives in their likeliest positions.

REMARKS

Claims 1-25 are pending. By this Preliminary Amendment, the specification is amended. No new matter is added.

Prompt and favorable consideration and prompt allowance are earnestly solicited.

Should the Examiner believe that anything further is desirable in order to place this

application in better condition for allowance, the Examiner is requested to contact the

Applicants' representative at the telephone number listed below.

The attached Appendix includes marked-up copies of each rewritten paragraph (37

C.F.R. 1.121(c)(1)(ii)).

Respectfully submitted,

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JAO:TJP/mlb
Attached: Appendix
Date: January 16, 2002

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DEPOSIT ACCOUNT USE
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APPENDIX

Changes to Specification:

The following is a marked-up version of the amended paragraph:

[003] Various attempts at remedying such problems have been performed. An example is U.S. Patent No. 5,303,313 to Mark et al., which provides a method of image enhancement through use of a compressed representative image. Another example is described in J.D. Hobby et al., "Enhancing degraded document images via bitmap clustering and averaging," ICDAR '97: *Fourth Int. Conference on Document Analysis and Recognition, 1997*. Both Patent No. 5,303,313 and the Hobby article provides a basic strategy. In Hobby, the strategy includes: clustering bitmaps, computing representatives for each cluster, ~~reclustering,~~ and then assembling an output. For initial clustering, Hobby uses a feature-based approach. To computer cluster representatives, Hobby uses a method that aligns the scans by centroids of black pixels, sums the scans to give a histogram, smooths the histogram to give a gray-level representative, and determines a polygonal outline that stays within a certain gray "tube" yet has a minimum number of inflection points. This computation method is described in J.D. Hobby and H.S. Baird, "Degraded Character Image Restoration", *Proc. 5th Annual Symp. On Document Analysis and Image Retrieval*, 1996, pps. 177-189. To align and form the assembled output, Hobby appears to use the alignment computed when computing cluster representatives. Patent No. 5,303,313 does not perform any reclustering, and instead is concerned primarily with compression.

[006] The methods and systems of this invention separately ~~avoid~~reduce image degradation that appear in the captured bilevel image.

[008] This invention separately provides systems and methods that have more reliable initial clustering, a reduction of clusters without introducing ~~new errors~~any significant decrease in image quality, super-resolved placement of representatives, and other image enhancement including breaking-up of run-together letters of text.

[009] In various exemplary embodiments of the methods and systems according to this invention, the output image may have higher resolution ~~of~~than the input image.

[0013] In various exemplary embodiments of the methods and systems according to this invention, cluster representations are determined by using a hill-climbing optimization procedure to approximate the most probable ~~double~~higher resolution representative. This

has the advantage that it can rigorously incorporate Bayesian priors and learned or guessed scanner distortion parameters resulting in more accurate sharp features and reliable overall blackness. However, other optimization procedures can be substituted.

[0015] In various exemplary embodiments of the methods and systems according to this invention, the assembly ~~replaces~~places representatives in their likeliest positions.